A Model for Assessing Risks of Operational Plans

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1. Introduction

Need

In early 2000, the senior managers of the Ministry of Forest (MOF) of the Kamloops Forest Region and the Ministry of Environment, Lands and Parks (MELP) identified an opportunity to develop a risk model that would improve the evaluation of risk and subsequent decision-making by Statutory Decision-Makers (SDMs).

Statutory Decision-Makers are expected, under the Forest Practices Code of British Columbia Act (FPC), to make decisions regarding forest operational plans and to support these decisions with good reasoning. In making these decisions, discretion is afforded to consider individual circumstances and factors in determining if operational plans meet the relevant tests of the FPC, specifically Sections 40 and 41.

Given the complexity of decisions asked of Statutory Decision-Makers, it is important for SDMs to understand and demonstrate how they have evaluated risks associated with operational plan approvals.

The *Risk Management & the Principles of Statutory Decision Making Handbook*, prepared by the Compliance & Enforcement Branch of the Ministry of Forests in October, 1998, provides a framework for evaluating environmental, social and economic risks. This framework, however, has not been consistently applied throughout the province in recent times. Critical questions have focused on how a decision was reached (the process), rather than on the results of the actual decision. Consequently, senior managers believed a risk model that provides further detail and guidance on applying the framework in the *Risk Management & the Principles of Statutory Decision Making Handbook* was needed.

Promoting and using a model such as follows will enable SDMs to better demonstrate a consistent approach in assessing risks associated with resource management decisions. SDMs consistently and reasonably utilising a model would likely be seen to have made a reasonable decision when their decision is evaluated by a group of their peers or formally challenged.

Scope

As discussed, this model supports and enhances the concepts of risk management presented in *Risk Management & the Principles of Statutory Decision Making Handbook,* and is consistent with the guidance provided in the Administrative Bulletin # 4, *Application of Section 41(1)(b) of the Forest Practices Code of British Columbia Act.*

In specific application, the model helps SDMs make decisions associated with operational plans submitted for approval under the Forest Practices Code. Appendix C presents the project Terms of Reference for developing the risk model.

Although the risk model employs numbers to represent relative risk factors, it relies on reasonable judgement and is not considered a quantitative model in the scientific sense. The basis for a final decision, however, may stem from a number of scientific or other professional assessments. These submitted assessments and plans possess the scientific information relevant to the decision. Proponents determine terrain stability, for example, prior to the use of this risk model by SDMs. The SDMs carefully consider the scientific information before them when using the risk model and in making a decision.

It is commonly understood that decisions consist of many different elements of the plan, including benefits, risks, and costs. This model deals only with the risk element of the overall decision in the evaluation of operational plans. The model does not directly lead the user through the benefits of taking the risks associated with the plan being reviewed.

In developing this model, the authors recognize the increasing desire to apply the "precautionary principle" in the face of scientific uncertainty and potentially serious consequences. Good risk management dictates that decision-makers use caution in management decisions where there is an absence of full scientific knowledge.

This model has been created after significant research and the evaluation of other jurisdictions that manage resource values similar to those under the SDM's care. Other jurisdictions reviewed include the Landslide Risk Assessment Associated with Forest Roads by the BC Ministry of Forests;

Environmental Risk Assessment (ERA) by the BC Ministry of Environment, Lands and Parks; British Columbia Hydro; Transport Canada's Railway Safety Management System; Canadian Water Resources Association; Dam Safety in the United States; the US Transportation Research Board; and the US Forest Service.

Intended Users

The authors have primarily designed the model for use by District Managers and Designated Environment Officials in their role as Statutory Decision-Makers. SDMs should, in approving operational plans, utilize methods and models such as this to communicate guidance or limitations that may apply to approvals. Nothing in this model dictates or influences the discretionary powers of the SDM.

As a "living document," this current version of the risk model will continue to be improved over time, based on the experience and suggestions of users. Comments on the model and examples should be forwarded to either of the Co-Chairpersons for the project:

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2. Decision Context

Prior to a decision on approving an operational plan, representatives of the DM and perhaps DEO engage in an ongoing exchange of information with the proponent to clearly communicate resource management objectives. This dialogue helps the licensee prepare a plan that meets all requirements of the Forest Practices Code, specifically in preparing their proposal to maximize the benefits and control risks of managing forest resources.

It is understood that, inherent in the FPC, the provincial government has already interpreted and given direction in most cases to managing environmental, social, and economic risks (e.g., referring to what proponents can or cannot do). To set the context for the decision covered by this model, consider the following discussion of the steps in risk

management for forest development and infrastructure maintenance or deactivation.

Steps in Risk Management

In preparing operational plans for approval under the Forest Practices Code, licensees generally follow five major steps in the management of risk, as outlined in Figure 1.

1. Identify Exposures and Understand Risks
2. Examine Risk Mitigation Options
3. Select Options and Develop Operational Plan
4. Does SDM Approve of the Operational Plan?
Not Approved
Approved
5. Implement and Monitor Plan

Figure 1. Flow Chart of Steps in Risk Management

The following paragraphs describe each of these five steps to identify the many opportunities available for licensees to practice risk management prior to submitting a plan for approval.

1. Identify Exposures and Understand Risks – In this initial stage of plan development, the proponent identifies benefits and risks associated with the proposed plan for forest resource management. MOF and MELP staff members often work with the proponents to facilitate an overview risk assessment and to identify key issues. At this early stage, the proponent works with stakeholders, including representatives of the SDM to understand the potential consequences of the plan. SDMs can significantly enhance this step by clearly communicating their resource and risk management objectives.

If the activity involves Small Business, representatives of the Ministry of Forests fulfill this role.

2. Examine Risk Mitigation Options – Licensees examine the many options available to reduce the probability or consequences of loss events associated with their proposed activities. The Forest Practices Code and related regulations dictate, in many respects, the type and extent of risk management techniques required, including loss avoidance. Agency staff members may assist in identifying methods that have been successful elsewhere. The plan proponent may confer with the SDM about specific expectations and appropriate levels of risk mitigation.

3. Select Options and Develop Operational Plans – The proponent selects risk management techniques in preparing the final operational plan. The SDM may advise in this process by identifying and clarifying the selection criteria they consider in approval decisions. Throughout these discussions, however, licensees retain ownership and full responsibility for their proposed operational plans, and have complete freedom within the context of the current legislative framework to submit plans of their choice.

4. Does SDM Approve the Operational Plan? – Once the proponent submits an operational plan for approval, the DM and the DEO, as required, decide on plan approval. It is at this point in the determination process that this model for evaluating risk applies. Basically, only two options are available:

- Approved
- Not Approved

In providing a written rationale for their decision, the SDM may highlight areas of risk concern that will assist the licensee in future revisions.

5. Implement Plan and Monitor Operations – The licensee bears full responsibility for implementing approved plans. Licensees are also responsible for monitoring their projects to manage foreseeable risks. It is understood that various provincial agencies monitor and inspect licensees operations.

Licensees and their representatives should refer to *Managing Risk within a Statutory Framework*, prepared by the Compliance & Enforcement Branch of the Ministry of Forests in March 1999, for more information on the basic principles of risk management.

3. The Risk Model

This Risk Model relies heavily on reasonable judgement by the SDM, using available information from staff and others. The Risk Model uses numbers to represent the relative magnitudes of frequency, probability, and consequences, but the model cannot be considered "quantitative" in the sense of scientific accuracy. Using numbers simply allows various risk factors to be weighed systematically during the risk evaluation process.

Description

The following description highlights the model for evaluating the risks associated with approving an operational plan. When an SDM receives an operational plan for approval, he or she must consider the acceptability of the plan, all things considered, including:

- Determine if the operational plan meets the required tests in Section 40 or 41 of the FPC

In doing so, the SDM may consider the following:

- The risks to a wide range of environmental, social and economic values
- The proposed mitigation of identified risks
- The potential benefits of the proposed plan or component

The Risk Model that follows offers guidance on the key steps in assessing risk, as discussed in the *Risk Management & Principles of Statutory*

Decision Making Handbook. The approach leads decision-makers to draw risk conclusions by considering:

Values of Concern – A list of these environmental, social and economic values is provided in the instructions for use.

Potential Detrimental Events (Loss Events) – These events are those that may cause loss or damage to an environmental, social or economic value.

Frequency of Loss Event – This refers to the presumed frequency of loss events, given the relevant information at hand. This factor assumes the implementation of the proposed activities and includes the contribution of the action to the frequency of background loss events. The greater the frequency of loss events, the greater the risk.

Probability of Consequences Given a Loss Event – Decisions should account for the likelihood of impact given a loss event. In essence, this step recognizes that decision-makers may be uncertain about some consequences, even with the best available scientific information. The greater the probability of consequences from a loss event, the greater the risk.

Consequences of Loss Events – SDMs should consider the potential consequences of an operational plan or component of it, giving thought to the temporal, spatial, synergistic and cumulative effects. Although the FPC specifies that plans must adequately manage and conserve forest resources, decision-makers should also consider potential impacts to other values, including public safety. The greater the consequences associated with an operational plan or component, the greater the risk.

Instructions

The following instructions describe how to apply this model. Each component of the Risk Model is presented and discussed in turn.

Refer to the Risk Assessment Matrix contained in Appendix A for a blank form.

To ensure consistent application of this model, users should not assign numerical values other than those suggested in any of the categories. When in doubt choose the higher risk value.

Project or Component Identification

The initial entry in the Risk Assessment Matrix identifies the project or component under consideration.

Project or Component Identification:

In the box entitled "Project or Component Identification," use any key words that identify the plan or component under review. In some cases, SDMs may wish to break a large project area into elements, such as cut blocks or roads for deactivation or by values at risk, to specifically distinguish risk areas. Briefly describe the distinguishing elements of the plan, block, or other component under examination.

Value(s) of Concern

The next step in the Risk Model calls for a clear recognition of the values at stake in the proposed plan. Values may take the form of environmental, social, or economic features or processes that may be exposed to potential harm by the proposed activities.

Value(s) of Concern:
What are the key values potentially affected by the project? Specify if required.

- ☐ Water Supply
- ☐ Fish Habitat
- ☐ Wildlife Habitat and Migration
- ☐ Forest Site Productivity
- ☐ Fish Population
- ☐ Wildlife Population
- ☐ Biodiversity
- ☐ Human Life, Private Property
- ☐ Utilities
- ☐ Landscape Values
- ☐ Recreational Values
- ☐ Other _____

In this box, identify prominent values that may be affected by the proposed activity, especially key environmental, social, or economic values. In most cases, the required information for this step will be found in the operational plan submitted for approval. Users of the model may wish to consider one value at a time, or consider the sum total of all concerns.

Potential Loss Event(s)

With a list of values, SDMs must also have a clear idea of the types of loss events that may occur associated with the project.

Potential Loss Event(s): What are the potential types of loss events associated with the project (e.g., landslide, flood, erosion)?

Use this area to identify the key incidents that could lead to loss. Such loss events may include the following:

- Animal diseases
- Debris flows
- Erosion events
- Floods
- Forest diseases
- Landslides
- Severe weather event
- Wildfire
- Other natural hazards that might occur in the area.

Frequency of Loss Events

An important factor to consider in a risk assessment deals with the frequency of loss events that could cause adverse consequences. Frequency is often expressed as the number of incidents in a given time frame, also called a "return period" for some types of events. For example, a loss event that occurs once a year poses a greater risk than an event that may occur once every decade or so.

A key element to consider at this point is any contribution of the operational plan to the background frequency of loss events, specifically the frequency that would continue in the future without the proposal. Consider if the proposal adds to, subtracts from, or maintains the current background frequency. Decision-makers should look for scientific information on this point among the assessment data provided by the proponent, and / or consult experts in the appropriate field.

Frequency of Loss Event(s): If the project proceeds, how frequently are loss events likely to occur?			
Frequent	**Occasional**	**Seldom**	**Rare**
The anticipated results of the proposed plan include frequent loss events, or represent a major addition to the background frequency of such events.	The anticipated results of the proposed plan include occasional loss events or represent a moderate addition to the background frequency of such events.	The anticipated results of the proposed plan include seldom loss events, or represent a minor addition to the background frequency of such events.	The anticipated results of the proposed plan include rare loss events, or represent an insignificant addition to the background frequency of such events.
Circle One **10**	**7**	**4**	**1**
Comments			

Consider the frequency of loss events if the proposed project were approved. Select from the following four categories:

Frequent (10 points) – The anticipated results of the proposed plan include frequent loss events, or represent a major addition to the background frequency of such events. For example, a flood incident occurring once a year on average may be considered a "frequent" event.

Occasional (7 points) – The anticipated results of the proposed plan include occasional loss events or represent a moderate addition to the background frequency of such events. Examples include a flood event occurring less than three or so times over a ten-year period.

Seldom (4 points) – The anticipated results of the proposed plan include seldom loss events, or represent a minor addition to the background frequency of such events. For example, a flood incident occurring once over a twenty-five year period or so may be considered as "seldom."

Rare (1 point) – The anticipated results of the proposed plan include rare loss events, or represent an insignificant addition to the background frequency of such events. A flood event that occurs once over a period of time greater than twenty-five years or so may be considered rare.

Record your determination of frequency in the comment space available, especially noting the aspects of the plan or project that, in your evaluation, contribute significantly to this risk factor.

Probability of Consequences

The realization of some consequences may be uncertain where risks are involved. Decision-makers should account for the level of uncertainty in their deliberations by recording their estimates of probability of consequences.

In this step, contemplate the likelihood of consequences given a loss event. For example, what is the chance of water quality degradation if a landslide occurs as a result of the proposed plan? In the study of probability, events that will definitely happen are assigned a probability of 100 percent. Incidents that are impossible are given a 0 percent chance of occurrence, and everything else lies somewhere between these two extremes.

Probability of Consequences: If the loss event occurs, what is the likelihood that the values will be impacted?		
Probable	**Possible**	**Unlikely**
Regardless of circumstances, consequences will probably occur. Probability exceeds 50%.	Consequences depend on a set of circumstances to occur. Probability lies between 20% and 50%.	Regardless of circumstances, consequences are unlikely to occur. Probability is less than 20%.
Circle One **7**	**4**	**1**
Comments		

Consider the following three levels of probability:

Probable (7 points) – Regardless of circumstances, the anticipated consequences will probably occur. The likelihood or probability of the consequence occurring is greater than 50 percent.

Possible (4 points) – The consequences depend on other factors or set of circumstances in order to occur. The probability of the consequence falls somewhere between 20 and 50 percent.

Unlikely (1 point) – Regardless of circumstances, the anticipated consequences are unlikely to occur. There is less than 20 percent chance that the consequences will occur.

Again, make a record of the probability factors you considered in selecting among the three broad categories of probability.

Most Likely Consequences

The next set of factors deal with the potential consequences of the plan or component, given a loss event, such as a landslide. In large part, this step requires decision-makers to consider the resources and other values that may be affected by the plan or component.

Most Likely Consequences: If values are impacted, what is the most likely extent of consequences?			
Catastrophic	**Major**	**Serious**	**Minor**
The plan or component could result in the release of energy that may harm people or cause extirpation of unique fish or wildlife species, or interruption of a community water supply.	The plan or component could result in the release of energy that may cause the long-term loss of private property, fish or fish habitat, wildlife or wildlife habitat, non-community water supply, or other key environmental resources.	The plan or component could result in the release of energy that may cause moderate-term loss to areas of moderate environmental, social or economic value, including non-community water supply.	The plan or component could only affect areas having low environmental, social or economic value, or result in short-term effects.
Circle One **10**	**7**	**4**	**1**
Comments			

Four categories of potential consequence are available.

Catastrophic (10 points) – The plan or component could result in the release of energy that may harm people or cause extirpation of unique fish or wildlife species, or interruption of a community water supply.

Major (7 points) – The plan or component could result in the release of energy that may cause the long-term loss of private property, fish or fish habitat, wildlife or wildlife habitat, non-community water supply, or other key environmental resources.

Serious (4 points) – The plan or component could result in the release of energy that may cause moderate-term loss to areas of moderate environmental, social or economic value, including non-community water supply.

Minor (1 point) – The plan or component could only affect areas having low environmental, social or economic value, or result in short-term effects.

Decision-makers weigh a great number of factors in determining the potential consequences of some plans. Potential consequences of an operational plan or component include impacts over time, specifically cumulative or synergistic effects. Inherent in this step, SDMs consider the cumulative aspects of the proposed operation, and whether enough information is at hand to predict the combined effects of past decisions.

Risk Management principles suggest, when in doubt, a more conservative decision may be appropriate, and specifically use of the precautionary principle may apply. In other words, select a category with more consequence points.

Briefly record the factors and features considered in making a determination of potential consequences. This will assist later in documenting your rationale for the decision, and assist the proponent in understanding your expectations in future plans.

Total Risk Level

In the evaluation of risk, consider all three factors: Frequency of loss events, probability that consequences will occur, and the extent of consequences to things of value. Combining these related risk elements is a mental process that defies a strictly scientific or structured approach. However, the model suggests a simple method that has been adopted in other types of risk decision-making: **Add the values for frequency and probability, then multiply the sum by the consequence value to determine a total risk score.**

If users apply this model consistently for two or more components of a plan, the scores will provide a rough indication of the relative risks of the components.

Total Risk
(Frequency + Probability) x Consequences =
_____ **Total Risk Score**
Comments

Risk Assessment Results

The foregoing analysis may be enough for some SDMs to make a determination on the operational plan under consideration. Plans that present either very high or very low risk often become quickly evident. However, recall that the assessment of risks associated with the plan is only one element to the overall decision on the plan. It is still necessary for the SDM to determine if, on a "balance of probabilities," the plan meets the tests in section 41(1) (a) and (b). The following table is offered to guide decision-makers after they have analyzed the risks.

Operational plans often identify mitigation measures to the risks of forest management and utilisation. Some mitigation may be required under the FPC, and other measures may simply represent good industrial practices. Remember that your determination should consider all of the mitigation measures identified in the operational plan submitted for approval.

If the plan promotes risks that are higher than acceptable to you, and the plan lacks reasonable means to manage these risks, you should avoid considering additional mitigation possibilities in your assessment. In doing so, you are drawing a conclusion on what is, rather than what could be in the plan and may then conclude that you should not approve the plan.

Document your decision by identifying specific risk concerns and include your thoughts on additional mitigation opportunities. You do not need to specify how to accomplish mitigation, only your opinion that more opportunities exist. The proponent will always have the opportunity to revise plans based on your comments and re-submit at a future date.

Total Risk Level
(Frequency + Probability) x Consequences =
_____ Total Risk Score
Comments

Risk Assessment Results

The foregoing analysis may be enough for some SDMs to make a determination on the operational plan under consideration. Plans that present either very high or very low risk often become quickly evident. However, recall that the assessment of risks associated with the plan is only one element to the overall decision on the plan. It is still necessary for the SDM to determine if, on a "balance of probabilities," the plan meets the tests in section 41(1) (a) and (b). The following table is offered to guide decision-makers after they have analyzed the risks.

Operational plans often identify mitigation measures to the risks of forest management and utilisation. Some mitigation may be required under the FPC, and other measures may simply represent good industrial practices. Remember that your determination should consider all of the mitigation measures identified in the operational plan submitted for approval.

If the plan promotes risks that are higher than acceptable to you, and the plan lacks reasonable means to manage these risks, you should avoid considering additional mitigation possibilities in your assessment. In doing so, you are drawing a conclusion on what is, rather than what could be in the plan and may then conclude that you should not approve the plan.

Document your decision by identifying specific risk concerns and include your thoughts on additional mitigation opportunities. You do not need to specify how to accomplish mitigation, only your opinion that more opportunities exist. The proponent will always have the opportunity to revise plans based on your comments and re-submit at a future date

Based on the total points for frequency, probability and consequence, identify the risk level associated with the plan or component. Then refer to the guidelines offered in the right-hand column.

Risk Assessment Results		
Points	**Risk Level**	**Assessment Results**
100 to 170	**Very High**	Likely represents an unacceptable level of risk. Significant mitigation measures are likely to be required so that the benefits outweigh the risks.
50 to 99	**High**	Potentially represents an unacceptable level of risk. Significant mitigation measures may be required so that the benefits outweigh the risks.
30 to 49	**Moderate**	Potentially represents an acceptable level of risk given the inclusion of mitigation measures, provided the benefits outweigh the risks.
10 to 29	**Low**	Likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.
2 to 9	**Very Low**	Very likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.

Decisions on plans or specific components may be clear where the model indicates risk levels of "very high" or conversely, "low" or "very low." Decisions that fall into the "high" or "moderate" risk levels may cause additional review depending on the situation, as there could be additional requirements to be met. Rather than following the point system exclusively, SDMs should consider additional factors in determining if the proposal meets FPC Section 40 or 41, including but not limited to the following questions:

Based on the total points for frequency, probability and consequence, identify the risk level associated with the plan or component. Then refer to the guidelines offered in the right-hand column.

Risk Assessment Results		
Points	**Risk Level**	**Assessment Results**
100 to 170	**Very High**	Likely represents an unacceptable level of risk. Significant mitigation measures are likely to be required so that the benefits outweigh the risks.
50 to 99	**High**	Potentially represents an unacceptable level of risk. Significant mitigation measures may be required so that the benefits outweigh the risks.
30 to 49	**Moderate**	Potentially represents an acceptable level of risk given the inclusion of mitigation measures, provided the benefits outweigh the risks.
10 to 29	**Low**	Likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.
2 to 9	**Very Low**	Very likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.

Decisions on plans or specific components may be clear where the model indicates risk levels of "very high" or conversely, "low" or "very low." Decisions that fall into the "high" or "moderate" risk levels may cause additional review depending on the situation, as there could be additional requirements to be met. Rather than following the point system exclusively, SDMs should consider additional factors in determining if the proposal meets FPC Section 40 or 41, including but not limited to the following questions:

- Are the mitigation measures identified in the operational plan likely to succeed?
- Is additional risk mitigation needed and would it be feasible? (See Appendix B for some suggested mitigation opportunities.)
- Is more information needed to estimate the risk levels?
- Are there plans to monitor potential impacts and take corrective action if unexpected effects arise?
- Do the potential benefits of the proposal clearly outweigh the risks?

As explained in Administrative Bulletin # 4, plans that include some risk but offer few or no benefits may be considered unreasonable. Likewise, some risks may be so high that acceptance of the plan is unlikely regardless of the potential benefits.

In all respects, decision-makers should record their reasoning for approving or not approving an operational plan. SDMs should refer to the frequency, probability, and consequence elements addressed in this Risk Model, with specific comments on the factors that contribute to the greatest risks.

4. References

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5. Risk Model Development Committee

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Facilitator:

Jim LaMorte, Risk Management Consultant, Integrated Risk Control, Inc., Victoria

Appendix - A Risk Assessment Matrix

Project or Component Identification:

Value(s) of Concern:
What are the key values potentially affected by the project? Specify if required.

- ☐ Water Supply
- ☐ Fish Habitat
- ☐ Wildlife Habitat and Migration
- ☐ Forest Site Productivity
- ☐ Fish Population
- ☐ Wildlife Population
- ☐ Biodiversity
- ☐ Other _____
- ☐ Human Life, Private Property
- ☐ Utilities
- ☐ Landscape (Visual) Features
- ☐ Recreational Features

Potential Loss Event(s):
What are the potential types of loss events associated with the project (e.g., landslide, flood, erosion)?

Frequency of Loss Event(s):
If the project proceeds, how frequently are loss events likely to occur?

Frequent	Occasional	Seldom	Rare
The anticipated results of the proposed plan include frequent loss events, or represent a major addition to the background frequency of such events.	The anticipated results of the proposed plan include occasional loss events or represent a moderate addition to the background frequency of such events.	The anticipated results of the proposed plan include seldom loss events, or represent a minor addition to the background frequency of such events.	The anticipated results of the proposed plan include rare loss events, or represent an insignificant addition to the background frequency of such events.
Circle One **10**	**7**	**4**	**1**
Comments			

Probability of Consequences: If the loss event occurs, what is the likelihood that the values will be impacted?		
Probable	**Possible**	**Unlikely**
Regardless of circumstances, consequences will probably occur. Probability exceeds 50%.	Consequences depend on a set of circumstances to occur. Probability lies between 20% and 50%.	Regardless of circumstances, consequences are unlikely to occur. Probability is less than 20%.
7	**4**	**1**
Comments		

Circle One

Most Likely Consequences: If values are impacted, what is the most likely extent of consequences?			
Catastrophic	**Major**	**Serious**	**Minor**
The plan or component could result in the release of energy that may harm people or cause extirpation of unique fish or wildlife species, or interruption of a community water supply.	The plan or component could result in the release of energy that may cause the long-term loss of private property, fish or fish habitat, wildlife or wildlife habitat, non-community water supply, or other key environmental resources.	The plan or component could result in the release of energy that may cause moderate-term loss to areas of moderate environmental, social or economic value, including non-community water supply.	The plan or component could only affect areas having low environmental, social or economic value, or result in short-term effects.
10	**7**	**4**	**1**
Comments			

Circle One

Total Risk Level
(Frequency + Probability) x Consequences = **_____ Total Points**
Comments

Prepared by:
Date:

Total Risk Level

(Frequency + Probability) x Consequences =

_____ **Total Points**

Comments

Prepared by:

Date:

Risk Assessment Results		
Points	**Risk Level**	**Assessment Results**
100 to 170	**Very High**	Likely represents an unacceptable level of risk. Significant mitigation measures are likely to be required so that the benefits outweigh the risks.
50 to 99	**High**	Potentially represents an unacceptable level of risk. Significant mitigation measures may be required so that the benefits outweigh the risks.
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10 to 29	**Low**	Likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.
2 to 9	**Very Low**	Very likely to represent an acceptable level of risk without additional risk mitigation measures, provided the benefits of the plan or component outweigh the risks.

Scoring Chart for Risk Assessment Results

Frequency		Probability		Consequences	
10	Frequent	7	Probable	10	Catastrophic
7	Occasional	4	Possible	7	Major
4	Seldom	1	Unlikely	4	Serious
1	Rare			1	Minor

Score = (F + P) x C

Score	Risk Level
50-99	High
30-49	Moderate
10-29	Low
2-9	Very Low

Freq	Prob	Cons	Prod
7	7	7	98
10	4	7	98
1	7	10	80
4	4	10	80
7	1	10	80
4	7	7	77
7	4	7	77
10	1	7	77
10	7	4	68
7	7	4	56
1	7	7	56
10	4	4	56
4	4	7	56
7	1	7	56
1	4	10	50
4	1	10	50
4	7	4	44
7	4	4	44
10	1	4	44
1	4	7	35
4	1	7	35
1	7	4	32
4	4	4	32
7	1	4	32
1	4	4	20
4	1	4	20
1	1	10	20
10	7	1	17
7	7	1	14
10	4	1	14
1	1	7	14
4	7	1	11
7	4	1	11
10	1	1	11
1	7	1	8
4	4	1	8
7	1	1	8
1	1	4	8
1	4	1	5
4	1	1	5
1	1	1	2

Scoring Chart for Risk Assessment Results

Frequency		Probability		Consequences	
10	Frequent	7	Probable	10	Catastrophic
7	Occasional	4	Possible	7	Major
4	Seldom	1	Unlikely	4	Serious
1	Rare			1	Minor

Score = (F + P) x C

Score	Risk Level
100-170	Very High
50-99	High
30-49	Moderate
10-29	Low
2-9	Very Low

Freq	Prob	Cons	Prod
10	7	10	170
7	7	10	140
10	4	10	140
10	7	7	119
4	7	10	110
7	4	10	110
10	1	10	110
7	7	7	98
10	4	7	98
1	7	10	80
4	4	10	80
7	1	10	80
4	7	7	77
7	4	7	77
10	1	7	77
10	7	4	68
7	7	4	56
1	7	7	56
10	4	4	56
4	4	7	56
7	1	7	56
1	4	10	50
4	1	10	50
4	7	4	44
7	4	4	44
10	1	4	44
1	4	7	35
4	1	7	35
1	7	4	32
4	4	4	32
7	1	4	32
1	4	4	20
4	1	4	20
1	1	10	20
10	7	1	17
7	7	1	14
10	4	1	14
1	1	7	14
4	7	1	11
7	4	1	11
10	1	1	11
1	7	1	8
4	4	1	8
7	1	1	8
1	1	4	8
1	4	1	5
4	1	1	5
1	1	1	2

Appendix - B Sample Mitigation Measures

Three principal mitigation strategies are available for consideration in forest operations:

> **Avoidance** – Risk avoidance reflects actions that eliminate the chance of loss from a specific hazard. Successful avoidance means either the hazard is eliminated completely or the things of value are completely removed from danger.
>
> **Loss Prevention** – Actions that reduce the frequency of a loss event, or the probability of consequences, are collectively referred to as loss prevention. These measures serve to reduce risk by lowering the likelihood of an event that can impact things of value.
>
> **Loss Reduction** – Loss reduction measures reduce the consequence portion of the risk equation. Efforts taken before an event can reduce the intensity of the impact, the magnitude of damage, or the importance of losses that may result.

Identifying effective mitigation measures in forest operations demands a creative process, thorough investigation, and careful planning. The table below offers some common examples of risk mitigation in forest management.

Mitigation Opportunities

The following mitigation options are presented in no order of cost or importance, and do not constitute a comprehensive list:

- Require more significant and specific inventories (i.e., Level A terrain mapping).
- Construct flumes or basins to control or catch debris torrents.
- Increase water management strategies (e.g., ditches, culverts).
- Modify method of harvesting, timing of activity, size, or resource use.
- Increase monitoring.
- Install early warning systems.
- Remove residents.
- Implement performance bonds.
- Perform periodic environmental auditing.
- Perform landscape rehabilitation.
- Require ecological restoration.
- Require vegetation restoration.

Appendix - C Terms of Reference

RISK MODEL PROJECT

OBJECTIVE:

To develop a risk based evaluation framework, by which Statutory Decision-Makers can evaluate various levels of complex information that may not be guided by legislation or policy, that will guide and aid their decisions on natural resource utilization and management.

TERMS OF REFERENCE:

1. Using a Risk Management Consultant, a workgroup consisting of MELP and MOF staff will develop a risk based evaluation model that meets the intent of the objective as stated above for use in the Kamloops Forest Region.
2. The Co-chairs of the project will be Laing Shimmin Kamloops Regional Water Manager, and Dave Hails Operations Manager, Salmon Arm Forest District.
3. The Salmon Arm Forest District will co-ordinate the contract for the Consultant and JV contributing resource centres appropriately.
4. Principle elements that must be incorporated within the model are:
   - the model will not cause decision-makers to avoid or eliminate risk, but rather help to assess and manage it;
   - that risk assessment is the process of determining the likelihood of loss or damage occurring and the magnitude of the consequences if the loss of damage occurs, and that this is not always a numerical exercise;
   - that risk management is the art of weighing the assessed risks against the expected benefits (social, environmental and economic) to make the best balanced management decision;
   - the model will include at least two working examples clearly demonstrating the applicability to resource use decisions currently facing Statutory Decision-Makers.
5. The group will meet at a central location as required (thought to be approximately 3 times, with each staff member's resource centre funding travel and per diems) and teleconference as necessary.
6. All work associated with this project is to be completed and a model implemented by March 31, 2001. Milestone dates for the project are as follows:
   - Complete a working draft model by November 30, 2000.
   - Complete a Statutory Decision-Maker / DEO review of the model within the Kamloops Forest Region and MELP's Southern Interior Region by December 31, 2000.
   - Finalize the draft model by January 31, 2001.
   - Implement (including training) the final model by March 31, 2001.
7. Members of the workgroup may be asked to help with any training initiatives associated with the model.